CLAIMS

1. An optical data recording method comprising the steps of: modulating data to be recorded, to generate a plurality of recording modulation codes; and emitting a pulse-like light beam to an optical disc, so that a plurality of recording marks and spaces which have lengths corresponding to the plurality of recording modulation codes are formed on the optical disc, wherein

at least two of the plurality of recording marks, comprising:

a first pulse which is disposed at a front and forms a leading edge of the recording mark,

a last pulse which is disposed at a backend and forms a trailing edge of the recording mark, and

a multi-pulse train which is disposed between the first pulse and the last pulse and forms a center of the recording mark,

the multi-pulse train having a pulse period longer than T which represents a reference period of the recording modulation code.

2. The optical data recording method according to claim 1, wherein the plurality of recording marks have different lengths represented by nT (n is an integral equal to or larger than 1) and at least two of the recording marks having different n are equal in the number of pulses included in the recording pulse train.

3. The optical data recording method according to claim 2, wherein a light beam generated by at least one pulse of the first pulse, the multi-pulse train, and the last pulse train is varied in irradiation power in at least two of the recording marks.

4. The optical data recording method according to claim 2, wherein each of the recording pulse trains in the

recording marks 2nT and (2n + 1)T includes an equal number of pulses in the plurality of recording marks.

5. The optical data recording method according to claim 2, wherein each of the recording pulse trains in the recording marks (2n - 1)T and 2nT includes an equal number of pulses in the plurality of recording marks.

6. The optical data recording method according to claim 1, wherein each of the first pulses has an equal pulse width in the plurality of recording marks.

7. The optical data recording method according to claim 1, wherein each of the last pulses have an equal pulse width in the plurality of recording marks.

8. The optical data recording method according to claim 1, wherein each of the multi-pulse trains has an equal pulse width and pulse interval in the plurality of recording marks.

9. The optical data recording method according to claim 1, wherein the plurality of recording marks include a recording mark formed by a light beam emitted according to the recording pulse train including only one pulse and a recording mark formed by a light beam emitted according to the recording pulse train including only the first pulse and the last pulse, and

the recording pulse trains have pulses each being 1T or more in pulse width.

10. The optical data recording method according to claim 1, wherein the plurality of recording marks include a recording mark formed by a light beam emitted according to the recording pulse train including only one pulse and a recording mark formed by a light beam emitted according to the recording pulse train including only the first pulse and the last pulse, and

the recording pulse trains have adjacent two pulses each being 1T or more in interval.

11. The optical data recording method according to claim 1, wherein in the recording pulse train, the multi-pulse area having the multi-pulse train disposed therein, amplitude and a position of at least one of the recording pulse train are set so that a multi-pulse duty or a multi-pulse amplitude average value is set at a predetermined value, the multi-pulse duty being obtained by dividing a pulse width of the multi-pulse train by a period of the multi-pulse train, the multi-pulse amplitude average value being obtained by dividing an amplitude integral of the multi-pulse area by a time width of the multi-pulse area.

12. The optical data recording method according to claim 11, wherein the multi-pulse train has a period set at 2T.

13. The optical data recording method according to claim 11, wherein the multi-pulse area is defined by rising timing of a front pulse of the multi-pulse train to

falling timing of a backend pulse of the multi-pulse train.

14. The optical data recording method according to claim 11, wherein the multi-pulse area is defined by falling timing of the first pulse to rising timing of the last pulse.

15. The optical data recording method according to claim 11, wherein the method sets rising timing for a front pulse of the recording pulse train and a pulse width for each pulse of the recording pulse train.

16. The optical data recording method according to claim 15, wherein setting is made so that a front space width between the first pulse and the front pulse of the pulse train and a backend space width between a backend pulse of the multi-pulse train and the last pulse are almost equal to each other.

17. The optical data recording method according to claim 11, wherein the plurality of recording modulation codes have different lengths represented by nT (n is an integer equal to or more than 1), and the set amplitude and position of at least one pulse of the recording pulse train are constant values regardless of a length of the recording modulation code.

18. The optical data recording method according to claim 11, wherein the plurality of recording modulation codes have different lengths represented by nT (n is an integer equal to or more than 1), and the set amplitude and position of at least one pulse of the recording pulse train are set at different values depending upon whether a length of the recording modulation code is an odd-numbered times or an even-numbered times as large as T.

19. The optical data recording method according to claim 11, wherein the plurality of recording modulation codes have different lengths represented by nT (n is an

integer equal to or more than 1), and the set amplitude and position of at least one pulse of the recording pulse train are set at different values according to a length of the recording modulation code.

20. The optical data recording method according to claim 11, wherein the plurality of recording modulation codes have different lengths represented by nT (n is an integer equal to or more than 1), the plurality of recording modulation codes are classified as a plurality of code groups, the set amplitude and position of at least one pulse of the recording pulse train are set at different values for each of the code groups.

21. The optical data recording method according to claim 11, wherein the plurality of recording modulation codes have different lengths represented by nT (n is an integer equal to or more than 1) and the multi-pulse duty or the multi-pulse amplitude average value is set at a

constant value regardless of a length of the recording modulation code.

22. The optical data recording method according to claim 11, wherein the plurality of recording modulation codes have different lengths represented by nT (n is an integer equal to or more than 1) and the multi-pulse duty or the multi-pulse amplitude average value is set at a different value depending upon whether a length of the recording modulation code is an odd-numbered times or an even-numbered times as large as T.

23. The optical data recording method according to claim 11, wherein the plurality of recording modulation codes have different lengths represented by nT (n is an integer equal to or more than 1) and the multi-pulse duty or the multi-pulse amplitude average value is set at a different value according to a length of the recording modulation code.

24. The optical data recording method according to claim 11, wherein the plurality of recording modulation codes have different lengths represented by nT (n is an integer equal to or more than 1), the plurality of recording modulation codes are classified as a plurality of code groups, and the multi-pulse duty or the multi-pulse amplitude average value is set at a different value for each of the code groups.

25. The optical data recording method according to claim 11, wherein the multi-pulse duty or the multi-pulse amplitude average value are determined by forming a recording mark using the recording pulse train, and evaluating an amplitude value around a center of a reproduction signal obtained by reproducing the formed recording mark.

26. A data recording device comprising:

a motor to place an optical disc thereon and rotate the optical disc;

an optical head having light source and emitting a light beam onto the optical disc placed on the motor;

a signal processing section modulating a data to be recorded and generating a plurality of recording modulation codes;

a recording pulse train generating section generating a plurality of recording pulse trains for driving the light source based on the recording modulation codes, so as to form on the optical disc a plurality of marks having lengths corresponding to the respective recording modulation codes,

wherein at least two of the plurality of recording marks being formed by a light beam emitted according to a recording pulse train, the recording pulse train, comprising:

a first pulse which is disposed at a front and forms a leading edge of the recording mark,

a last pulse which is disposed at a backend and forms a trailing edge of the recording mark, and

a multi-pulse train which is disposed between the first pulse and the last pulse and forms a center of the recording mark,

the multi-pulse train having a pulse period longer than T which represents a reference period of the recording modulation code.

27. The data recording device according to claim 26, wherein the plurality of recording marks have different lengths represented by nT (n is an integral equal to or larger than 1) and at least two of the recording marks having different n are equal in the number of pulses included in the recording pulse train.

28. The data recording device according to claim 26, wherein a light beam generated by at least one pulse of the first pulse, the multi-pulse train, and the last pulse train is varied in irradiation power in at least two of the recording marks.

29. The data recording device according to claim 26, wherein in the recording pulse train, the multi-pulse area having the multi-pulse train disposed therein, amplitude and a position of at least one of the recording pulse train are set so that a multi-pulse duty or a multi-pulse amplitude average value is set at a predetermined value, the multi-pulse duty being obtained by dividing a pulse width of the multi-pulse train by a period of the multi-pulse train, the multi-pulse amplitude average value being obtained by dividing an amplitude integral of the multi-pulse area by a time width of the multi-pulse area.

30. The data recording device according to claim 26, wherein the multi-pulse train has a period set at 2T.